

526,833

(12) INTERNATIONAL PUBLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



05 MAR 2005

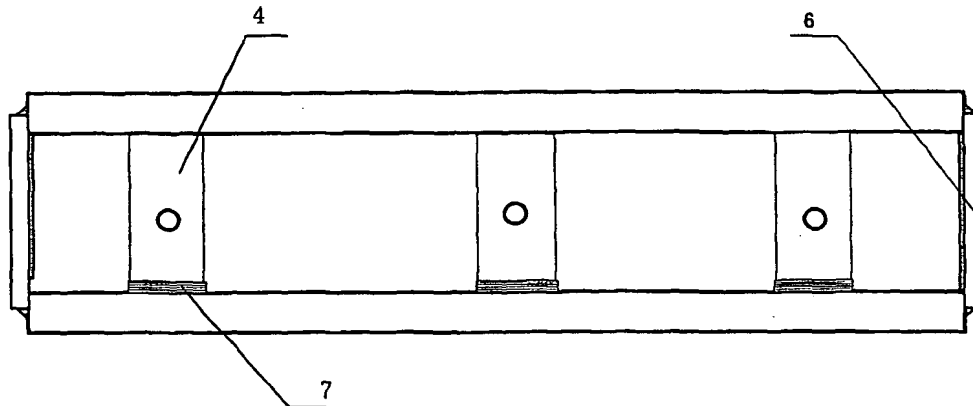
(43) International Publication Date  
18 March 2004 (18.03.2004)

PCT

(10) International Publication Number  
**WO 2004/022898 A1**

- (51) International Patent Classification<sup>7</sup>: **E06B 3/66**, 3/663, C03B 23/24, C03C 27/06
- (21) International Application Number: **PCT/CN2003/000277**
- (22) International Filing Date: 17 April 2003 (17.04.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 02129576.X 5 September 2002 (05.09.2002) CN
- (71) Applicant (for all designated States except US): **BOE TECHNOLOGY GROUP CO.,LTD** [CN/CN]; No.10 Jiuxianqiao Road, Chaoyang District, Beijing 100016 (CN).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **WU, Jusheng** [CN/CN]; No.10 Jiuxianqiao Road, Chaoyang District, Beijing 100016 (CN). **LI, Hongyan** [CN/CN]; No.10 Jiuxianqiao Road, Chaoyang District, Beijing 100016 (CN).
- (74) Agents: **BELJING LEADER PATENT AGENCY CO.,LTD** et al.; Daolong Building, No.13 Huayuanlu, Haidian District, Beijing 100088 (CN).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: EVACUATED GLASS PANEL AND METHOD OF FIXING SUPPORT MEANS, DISPOSED THEREIN



(57) Abstract: The present invention discloses an evacuated glass panel and a method of fixing support means, disposed therein. A method of fixing support means (4, 4a, 4b) disposed within an evacuated glass panel, said evacuated glass panel includes a top planar glass sheet (1, 1a, 1b), a bottom planar glass sheet (2, 2a, 2b), support means (4, 4a, 4b) and seal component (6, 6a, 6b) around the periphery of planar glass sheet, wherein said support means (4, 4a, 4b) is disposed between the top and bottom planar glass sheet; said support means (4, 4a, 4b) are adhered to the surface of bottom planar glass sheet (2, 2a, 2b) through residual solution layer (7, 7a, 7b); the cavity between top and bottom planar glass sheet is vacuum, said fixing method including following steps: at first apply a solution layer (7, 7a, 7b) on surface of planar glass sheet, on which the support means (4, 4a, 4b) is disposed; secondly, place the support means (4, 4a, 4b) on said solution layer (7, 7a, 7b); at last cover the upper surface of support means (4, 4a, 4b) with a planar glass sheet, and heat said solution layer (7, 7a, 7b) to dry, so as to fix said support means (4, 4a, 4b) between planar glass sheets.

WO 2004/022898 A1

## EVACUATED GLASS PANEL AND METHOD OF FIXING SUPPORT MEANS, DISPOSED THEREIN

### Technical Field

The present invention relates to a kind of evacuated glass panel and a method of fixing support means, disposed therein, particularly, a method of fixing support means, disposed therein, which is convenient to large scale production and able to increase the productivity of evacuated glass panel, and said method can employed for manufacturing high thermo and sound-insulating glass panel. The present invention concerns the technical field of glass manufacturing

### Background of the Art

The well-known evacuated (vacuumized) glass panel generally includes two or more planar glass sheets. Due to the evacuated state between the planar glass sheets, heat can not be transferred by convection manner, and at same time a effective barrier for sound transfer is generated, such, evacuated glass panel is also referred to as high thermo and sound-insulating evacuated glass panels.

The evacuated state between the planer glass sheets and atmospherical pressure effecting on outer surface of planar glass sheets make it possible to cause opposite deformation of planar glass sheets in evacuated glass sheets in evacuated glass planar and even to make the glass sheets fracture. Therefore, during the manufacturing process of evacuated glass planar, a plurality of support means disposed between planar glass sheets are always used, and make the distribution of disposed support means as uniform as possible, so that to resist the atmospherical pressure on planar glass sheets, and thus maintain the shape of planar glass sheets not easy to deform or rupture.

Disposing support means within the evacuated glass panel will bring some problems: influence on transmissivity of evacuated glass panel, particularly, colorless transparent evacuated glass panel, and when the support means has large cross section, it not only has influence on transmissivity of evacuated glass panels, but also makes it short of a esthetic sense. Therefore, a solution to said problems is to use smaller size transparent glass support means. However, this method brings certain difficulty in manufacturing evacuated glass panel.

In order to dispose support means between glass sheets of evacuated glass panel, there is an operation of placement of support means during manufacturing process.

Due to use smaller cross section support means , a great number of support means is necessary to place, especially during manufacturing large size evacuated glass panels. At the time of placing support means, because a large number of support means is need to place, moreover, the two bottoms of support means may be not parallel, and commonly the surface of planar glass sheet is not very even and the height between support means is different, so that the support means, disposed on planar glass sheet is easy to turn down, specially, when move the planar glass sheet on which support means are disposed, the possibility of support means to turn down is increased.

Besides due to the difference of height between support means, after completion of manufacturing evacuated glass panel, some support means which have lower height are able to be moved, particularly, when install the evacuated glass panel vertically, the support means is easy to fall off under its gravity. The fall off regarding to support means leads to non-uniform support force on planar glass sheet, and under the atomspherical pressure, the planar glass sheet is easy to deform, and the inner stress of evacuated glass panel is also accordingly increased. The evacuated glass panel is trend toward fractured during accident collision, even if the force is very low.

It is appreciated, from above-mentioned, the problem of turn-down and fall off regarding to support means exert tremendous influence not only on productivity of evacuated glass panel, but also on service quality of finished evacuated glass panel. Therefore, such a problem must be resolved as fast as possible.

### Summary of the Invention

The main object of the present invention is to provide a method of fixing support means within evacuated glass panels. Adopt proposed fixing method makes small support means can be stably placed on planar glass sheet, including said high thermo and sound-insulating glass panel. Even if the planar glass sheet is moved or the finished evacuated glass panel is vertically assembled, no turn down and fall off of support means will occur so that the productivity of evacuated glass panel and quality of finished evacuated glass panel is increased.

The secondary object of the present invention is to provide a method of fixing support means within evacuated glass panels. Use proposed fixing method makes manufactured evacuated glass panel obtain a specific functional layer on its inner surface, therefore it can result in more wide application.

The further object of the present invention is to provide an evacuated glass panel, that have support means disposed therein according to proposed fixing method. Said evacuated glass panel has not only good high thermo and sound-insulation property,

but also good mechanical strength and specific applicable function.

Above objects of this invention are realized through following technical schemes:

A method of fixing support means within evacuated glass panel, said evacuated glass panel includes at least two layers of any shape planar glass sheets and support means disposed in interior, disposed therein, characterized in that said method comprising at least following steps of:

At first apply a solution layer on surface of planar glass sheet, on which the support means are disposed;

Secondly, place the support means on said solution layer;

At last, cover the upper surface of support means with a planar glass sheet, and heat said solution layer to dry, so as to fix said support means between planar glass sheets. Said solution layer entirely or partly covers or locates planar glass sheet's surface, on which the support means is disposed in order to manufacturing evacuated glass panel, having various specific function. Said planar glass sheet, on which support means is disposed, is a top planar glass sheet or an intermediate planar glass sheet. Said heating method is a oven drying or sintering.

An evacuated glass panel according to this invention, comprising: a top planar glass sheet, a bottom planar glass sheet, support means and seal component around the periphery of planar glass sheet, characterized in that, said support and bottom planar glass sheets; said support means are adhered to the surface of bottom planar glass sheet through residual solution layer; the cavity between top and bottom planar glass sheets is a vacuum. Said support means is solid or hollow pillar said hollow pillar has opened penetrated portion at its side or top surface, for communication of space between planar glass sheets with the inner cavity of hollow pillar. Said support means is more than two on top planar glass sheet, and uniformly disposed on surface of bottom planar glass sheet or on upper surface of top planar glass sheet.

Said residual solution layer is an adherent layer formed after volatilization of organic or non-organic solution during glass manufacturing process; said adherent layer entirely or partly covers or locates the surface of bottom planar glass sheet or upper surface of top planar glass sheet. Said sealing component is used to vertically seal and join to edge frame component around the periphery of planar glass sheet; said edge frame component will through sintering and make the low melting point glass powers applied on its inner side melt and cool, and then join to the periphery of said planar glass sheet.

With regard to shortages of prior evacuated glass panel, the present invention proposes: a method of placing the support means on surface of planar glass sheet through adhesion during the process of glass manufacturing. Using said method, it can maintain uniform force receiving of planar glass sheet on the one hand, and resolve the problem of movement of support means within evacuated glass panel on

the other hand, resulting a good quality level for the evacuated glass panel.

The present invention has following advantages:

Because the immersion and surface tension effect of liquid, using said method for placing support means in evacuated glass panel make the support means can not be moved in succedent operations, so as to simplify the operations, reduce cost and increase operating effectiveness.

Using said method for placing support means in evacuated glass, through heating operation in manufacturing process of evacuated glass panel, due to presence of residual matter of organic solution, as well as non-volatilizable matter of non-organic material, specially, at periphery around the end of support means the residual matter is collected relatively more because of surface tension of liquid, Therefore, said method has following advantages: because the hardness of residual matter is far lower than that of support means or glass, so a buffering layer is formed. This buffeing layer increase mechanical strength of the evacuated glass panel and overcome the problem of non-uniform stress which come from the different size of support means generated in compression process of evacuated glass panel; the residual matter adheres support means and planar glass sheets together without moving of support means; if solution material having higher infrared reflecting ability of infrared ray, the manufactured glass panel will be effective to reduce thermal conductivity.

Using high thermo and sound insulating evacuated glass panel made by said method, overcomes the disadvantage of different size of support means and movement thereof, thereby increasing the mechanical strength and practical applicability of evacuated glass panels.

### **Brief Description of the Drawing**

Fig.1 is a schematic cross sectional view of an embodiment with covered rosin spirit solution layer according to this invention;

Fig.2 is a schematic cross sectional view of embodiment in Fig.1 after completion of manufacture;

Fig.3 is a schematic cross sectional view of an embodiment having three planar glass sheets with covered solution layer according to this invention;

Fig.4 is a schematic cross sectional view of embodiment in Fig3 after completion of manufacture;

Fig.5 is schematic cross sectional view of an embodiment with tin chloride solution;

Fig.6 is a schematic cross sectional view of embodiment in Fig.5 after completion of

manufacture.

### Preferred embodiment

The present invention will be described in more detail by way of embodiment with referring to accompanying drawings as follows.

#### Example 1:

As shown in Fig 1 this embodiment according to the present invention uses a rosin spirit solution for adhering support means. The evacuated glass panel comprising: a top planar glass sheet 1 and a bottom planar glass sheet 2; a layer of organic rosin spirit solution 5 is entirely rolled on surface of bottom planar glass sheet 2; between two planar glass sheets support means 4 is in form of transparent glass pillar with penetrated hole 41; at periphery around planar glass sheet a glass seal component 6 is placed. The manufacturing process of said evacuated glass panel include following steps:

At first apply a layer of organic rosin spirit solution on surface of bottom planar glass sheet 2 by way of entirely rolled on.

Secondly, uniformly place support means 4 as required on surface of bottom planar glass sheet 2. Because of the immersion and surface tension effect of liquid the support means 4 is not easy to be moved. As show in Fig2, at successive operations of evacuated glass manufacture, a glass seal component 6 is sealed and joined on periphery around planar glass sheets through sintering. At the end of said manufacturing process, because of higher temperature of seal and join (i.e. 400° C) the rosin spirit solution 5 is dried. Moreover, during evacuation of air from intermediate layers between planar glass sheets, the volatilized vapor of rosin spirit solution is bled out at the same time.

Because rosin spirit solution 5 is able to leave a residual layer 7 at process of drying, specially, the residual matter is collected relatively more at periphery around the end of support means 4 due to surface tension of liquid.

Moreover, because the hardness of residual layer 7 is far lower than that of support means or glass, so a buffering layer is formed, thereby increasing the mechanical strength of evacuated glass panel and over coming the problem identified by non-uniform stress in glass resulted from different size of support means 4 in compression process of evacuated glass support means and planar glass sheets together, without moving of support means 4.

#### Example 2:

As shown in Fig 3, 4 this embodiment according to the present invention use a solution layer for adhering support means in manufacturing three-layer evacuated glass panel.

The hollow three-layer evacuated glass panel comprising: a top planar glass sheet 1a, a middle planar glass sheet 3, a bottom planar glass sheet 2a; a layer of indium oxide water solution 5a at upper surfaces of middle planar glass sheet 3 and bottom planar glass sheet 2a is entirely rolled on; solid main support means 4a are disposed  
5 between three layer of planar glass sheets, a glass seal component 6a is placed at periphery around planar glass sheet.

The manufacturing process of said evacuated glass panel including following steps:

At first apply a layer of indium oxide solution 5a on surface of middle planar glass sheet 3 and bottom planar glass sheet 2a by way of entirely rolled on.

10 Secondly, according to requirement place support means 4a on surface of middle planar glass sheet 3 and bottom planar glass sheet 2a above the solution layer 5a.

At last, slightly compress said three layers of planar glass sheets and carry out successive sintering operation.

15 In above embodiment, the effect of indium oxide solution is similar to that of organic rosin spirit solution in example 1. After sintering the residual layer 7a gives a good adhering effect on support means 4a. During production or practical assembly, the support means 4a cannot be moved or fall off.

Evacuated glass panel made by this method has good operational performance.

Example 3:

20 As shown in Fig 5,6, this embodiment according to the present invention use a tin chloride solution layer for adhering support means. Said embodiment is an evacuated glass panel, comprising a top planar glass sheet 1b and a bottom planar glass sheet 2b; the upper surface of bottom planar glass sheet 2b is entirely covered by a layer of tin chloride solution 5b; between two planar glass sheets a support  
25 means 4b is disposed; said support means 4b is a hollow glass pillar 4b with penetrated notch 41b, through said penetrated notch the space between planar glass sheets is communicated with inner cavity of support means, thereby ensuring evacuated state within support means after evacuation of space between planar glass sheets. At periphery around planer a glass sheet metal seal component 6b is disposed.

30 During sintering process, the low melting point glass powder on inner side of metal seal component 6b is melted and after solidified on inner portion around the periphery of said metal seal component 6b and planar glass sheet, realizing the sealing of evacuated glass panel. In said glass manufacturing process the effect of tin chloride solution is similar to that of above example 1, further description is omitted.

35 It should be noted that the layer of tin chloride solution 5b became a residual layer of tin chloride 6c after sintering operation. The function of said residual layer of tin chloride 6c is not only adhering and fixing effect, but also covering the surface of bottom planar glass sheet 2b.

Because of good infrared reflecting and electric conducting effect of residual tin

oxide layer 6c this glass can effectively reduce thermo conductivity of glass. Said two layer evacuated glass panel after evacuation will have better high thermo and sound-insulating ability, as well as good electric conductivity, and thereby lead to a wide application.

- 5 At last, it should be noted, that above-mentioned embodiments are employed only for description of the technical schemes of the present invention and should not be limited thereon, although the present invention has been detailed described, it should be apparent to those of ordinary skilled in the art that modifications and variations may be made without departing from the spirit and scope of the technical schemes of
- 10 the present invention, all they should be included within the scope of appended claims.



## Claims

1. A method of fixing support means disposed within an evacuated glass panel, said evacuated glass panel includes at least two layers of any shape planar glass sheets and support means disposed in interior, disposed therein characterized in that said method comprising at least following steps of:  
5       At first apply a solution layer on surface of planar glass sheet, on which the support means is disposed;  
          Secondly, place the support means on said solution layer;  
          At last, cover the upper surface of support means with a planar glass sheet, and  
10       heat said solution layer to dry, so as to fix said support means between planar glass sheets.
2. The method of fixing support means disposed within an evacuated glass panel according to claim 1, wherein said solution layer entirely or partly covers or  
15       locates planar glass sheet's surface on which the support means is disposed in order to manufacture evacuated glass panel having various specific function.
3. The method of fixing support means disposed within an evacuated glass panel according to claim 1 or 2, wherein said solution layer is applied by way of rolling,  
20       spraying or printing.
4. The method of fixing support means disposed within an evacuated glass panel according to claim 3, wherein said solution layer is an organic or non-organic solution layer.  
25
5. The method of fixing support means disposed within an evacuated glass panel according to claim 4, wherein said organic solution is rosin spirit.
6. The method of fixing support means disposed within an evacuated glass panel according to claim 4, wherein said non-organic material is indium oxide or tin  
30       chloride.
7. The method of fixing support means disposed within an evacuated glass panel according to claim 1, wherein said planar sheet, on which support means are  
35       disposed, is top planar glass sheet or intermediate planar glass sheet.
8. The method of fixing support means within an evacuated glass panel according to

claim 1, wherein said dry manner is an oven drying or sintering.

5 9. An evacuated glass panel, comprising a top planar glass sheet, a bottom planar glass sheet, support means and seal component around the periphery of planar glass sheet, wherein said support means is disposed between the top and bottom planar glass sheets; said support means are adhered to the surface of bottom planar glass sheet through residual solution layer; the cavity between top and bottom planar glass sheets is vacuum.

10 10. The evacuated glass panel according to claim 9, wherein the upper surface of said top planar glass sheet has upper support means adhesively disposed through residual solution layer; the top portion of said upper support means covers with another planar glass sheet; the cavity between said another planar glass sheet is vacuum, a seal component is disposed around them.

15 11. The evacuated glass panel according to claim 9 or 10, wherein said upper support means is a solid or hollow pillar; said hollow pillar has a penetrated portion at its side or upper surface; through said penetrated portion the space between planar glass sheets is communicated with inner cavity of hollow pillar.

20 12. The evacuated glass panel according to claim 9 or 10, wherein said support means is more than two upper support means, uniformly disposed on surface of bottom planar glass sheet or on upper surface of top planar glass sheet.

25 13. The evacuated glass panel according to claim 11, wherein said penetrated portion is a hole or notch, through which the inner cavity of hollow pillar is communicated with the space between planar glass sheets; said hole is opened at side surface of hollow pillar; said notch is opened at upper end portion of hollow pillar.

30 14. The evacuated glass panel according to claim 9 or 10, wherein said residual solution layer is an adherent layer formed after volatilization of organic or non-organic solution; said adherent layer entirely or partly covers or locates surface of bottom planar glass sheet or upper surface of top planar glass sheet.

35 15. The evacuated glass panel according to claim 14, wherein said organic solution is rosin spirit.

16. The evacuated glass panel according to claim 14, wherein said non-organic

material is indium oxide or tin chloride.

- 5 17. The evacuated glass panel according to claim 9 or 10, wherein said seal component is used to vertically seal and joint to the edge frame component around the periphery of planar glass sheet; said edge frame component will thorough sintering and make the low melting point glass powers applied on its inner side melt and cool, and then join on the periphery of said planar glass sheet.
- 10 18. The high thermo and sound-insulating evacuated glass panel according to claim 17, wherein said seal component is a glass strip or metal frame.

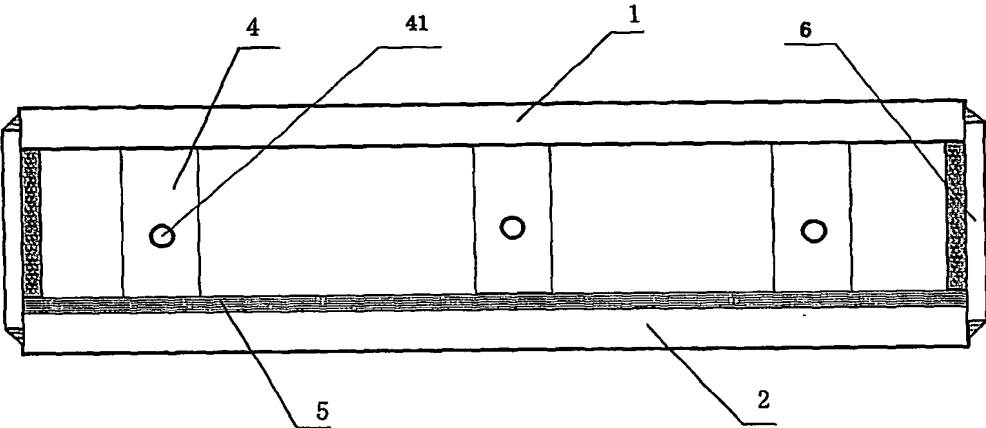


Figure 1

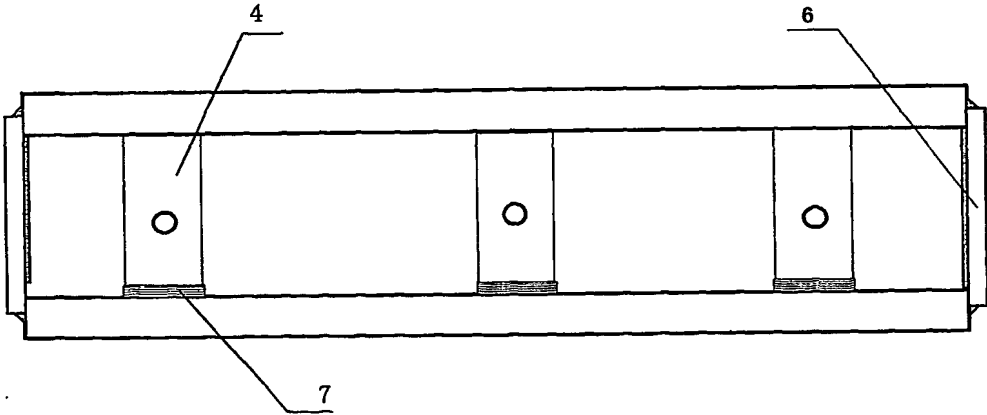


Figure 2

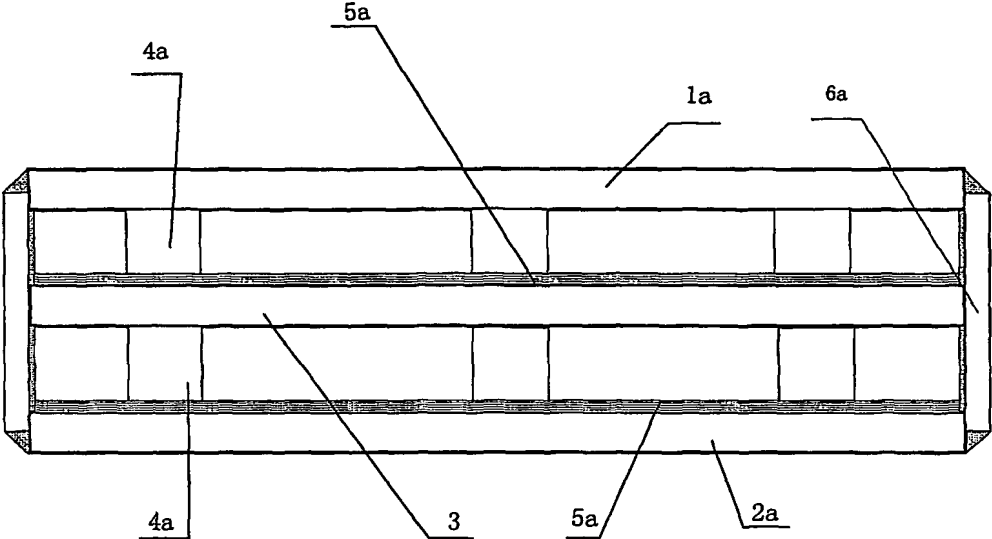


Figure 3

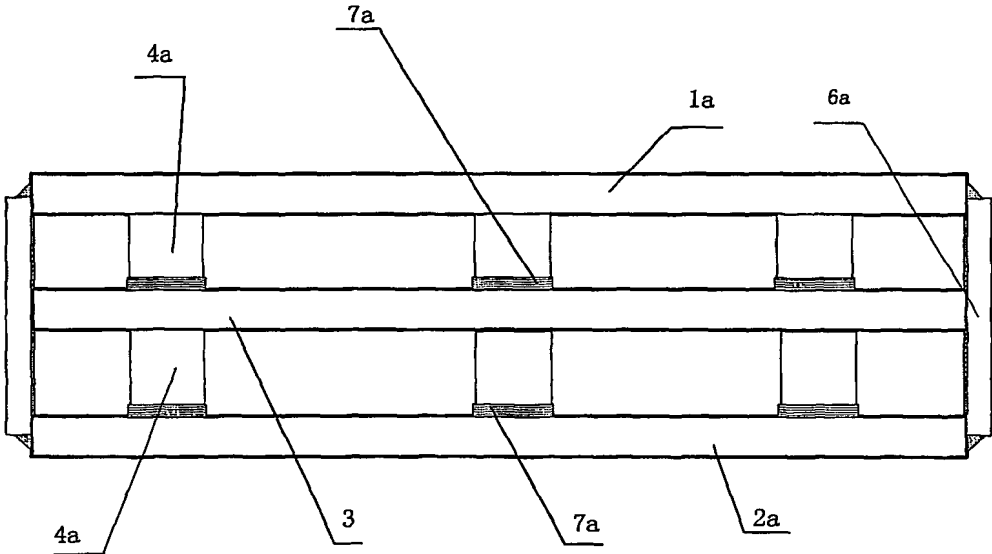


Figure 4

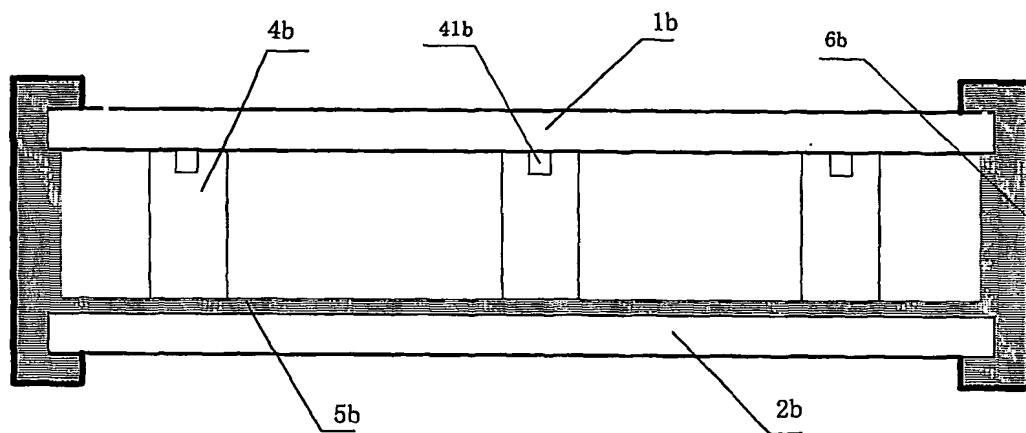


Figure 5

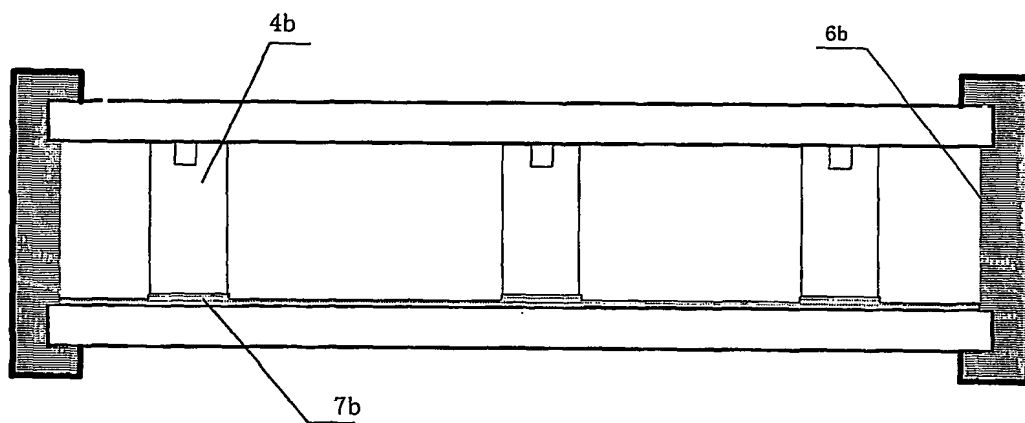


Figure 6

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN03/00277

## A. CLASSIFICATION OF SUBJECT MATTER

IPC<sup>7</sup> E06B3/66、E06B3/663、C03B23/24、C03C27/06

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC<sup>7</sup> E06B、C03B、C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Chinese Patent Documents (1985~)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ, CNPAT

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN,A,1206389 ( (NIPG) NIPPON SHEET GLASS CO LTD) 27.Jan.1999 (27.01.1999) The whole description; claim 1~10; figure 1~4	1~18
A	CN,A,1246450( (QINH-N) QINHUANGDAO DESIGN INST GLASS IND STATE) 08.Mar.2000 (08.03.2000) The whole description; claim 1~6; figure 1~4	1~18

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"C" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 8 Jul, 2003	Date of mailing of the international search report 28 AUG 2003 (28.08.03)
Name and mailing address of the ISA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer Zhang Yamei Telephone No. 86-10-62093490



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/CN03/00277

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN,A,1266470 ( (NIPG) NIPPON SHEET GLASS CO LTD) 13.Sept.2000 (13.09.2000)  The whole description; claim 1~4; figure 1~7	1~18
A	CN,A,1128320 (Jinguangheng) 07.Aug.1996 (07.08.1996)  The whole description; claim 1~17; figure 1~9	1~18
A	US,A,5657607 (University of Sydney) 19.Aug.1997 (19.08.1997)  The whole description; claim 1~27; figure 1~13	1~18
A	US,A,3990201 ((FALB-I) FALBEL G) 09.Nov.1976 (09.11.1976)  The whole description; claim 1; figure 1~4	1~18
A	DE,A,3615179 ((VIER-I) VIERT K P) 19.Feb.1987 (19.02.1987)  The whole description; claim 1~5	1~18
A	WO,A,9957406 ( (NIPG) NIPPON SHEET GLASS CO LTD) 11.Nov.1999 (11.11.1999)  The whole description; claim 1~18; figure 1~61	1~18
A	CN,A,1094475 (Wangminzhi) 02.Nov.1994 (02.11.1994)  The whole description; claim 1; figure 1~2	1~18



